Policy or the Environment? IPCC or LCA?

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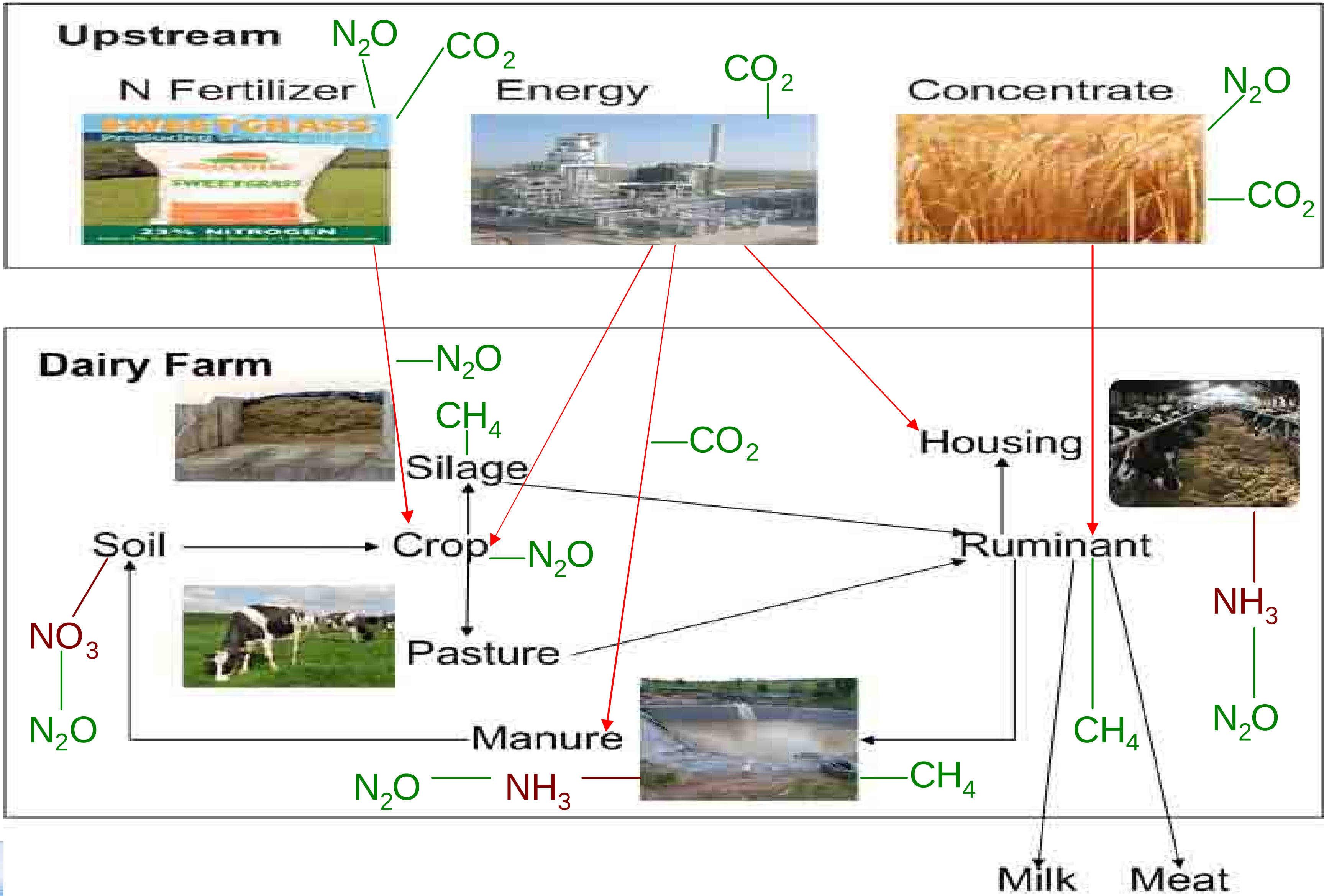
Outline

- Greenhouse Gas (GHG) quantification methods
  - Intergovernmental Panel on Climate Change (IPCC)
  - Life Cycle Analysis (LCA)
- GHG modelling
- IPCC and LCA analysis
  - Genotype and Feed System comparisons

IPCC versus LCA



Intergovernmental Panel on Climate Change

- Signatory nations of UNFCCC obliged to submit national inventories of GHG emissions (UN,1992)

- 1995 IPCC method published (Revised 1996)
  - National approach
  - Sector based Framework
    - Agriculture
    - Land use change and Forestry
    - Solvents and other Product use
    - Industrial Processes
    - Energy
    - Waste

Intergovernmental Panel on Climate Change

- Revised 1996 IPCC method used to assess nations Kyoto Protocol emission targets 2008-2012

- Greenhouse Gases subject to quantified reductions
  - Carbon dioxide (CO_2)
  - Methane (CH_4)
  - Nitrous oxide (N_2O)
  - Hydroflurocarbons (HFCs)
  - Perflurocarbons (PFCs)
  - Sulfur hexafluroide (SF_6)

Life Cycle Analysis

- Environmental Systems Approach developed 1969-1974
- Goal of LCA to assess the environmental impacts associated with a product i.e. GHG emissions, non-renewable energy use
- 1997 International Organization for Standardization (ISO) published standard LCA steps
  - Goal and Scope definition (ISO 14041)
  - Inventory analysis (ISO 14041)
  - Impact assessment (ISO 14042)
  - Interpretation (ISO 14043)

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Dairy farm GHG model

- IPCC and LCA methods
  - Whole Farm Model (Moorepark Dairy System Model; Shalloo et al., 2004)
  - GHG model (O'Brien et al., 2010)

- Whole farm model used to define key parameters for GHG model (e.g. feed budget)

- GHG model integrates farm model parameters with specific emission/removal factors

Dairy farm GHG model

- GHG emissions converted to CO_2 equivalents with 100 year time horizon (CO_2e)
  - CO_2 = 1; CH_4 = 25; N_2O = 298 (IPCC, 2006)

- GHG emissions expressed;
  - Per unit area (t CO_2e/ha)
  - Per unit product (kg CO_2e/kg milk and kg CO_2e/kg milksolids (MS))

- LCA GHG emissions allocated between milk and meat
  - Biological allocation

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Influence of Genotype and Feed System on GHG emissions from dairy farms

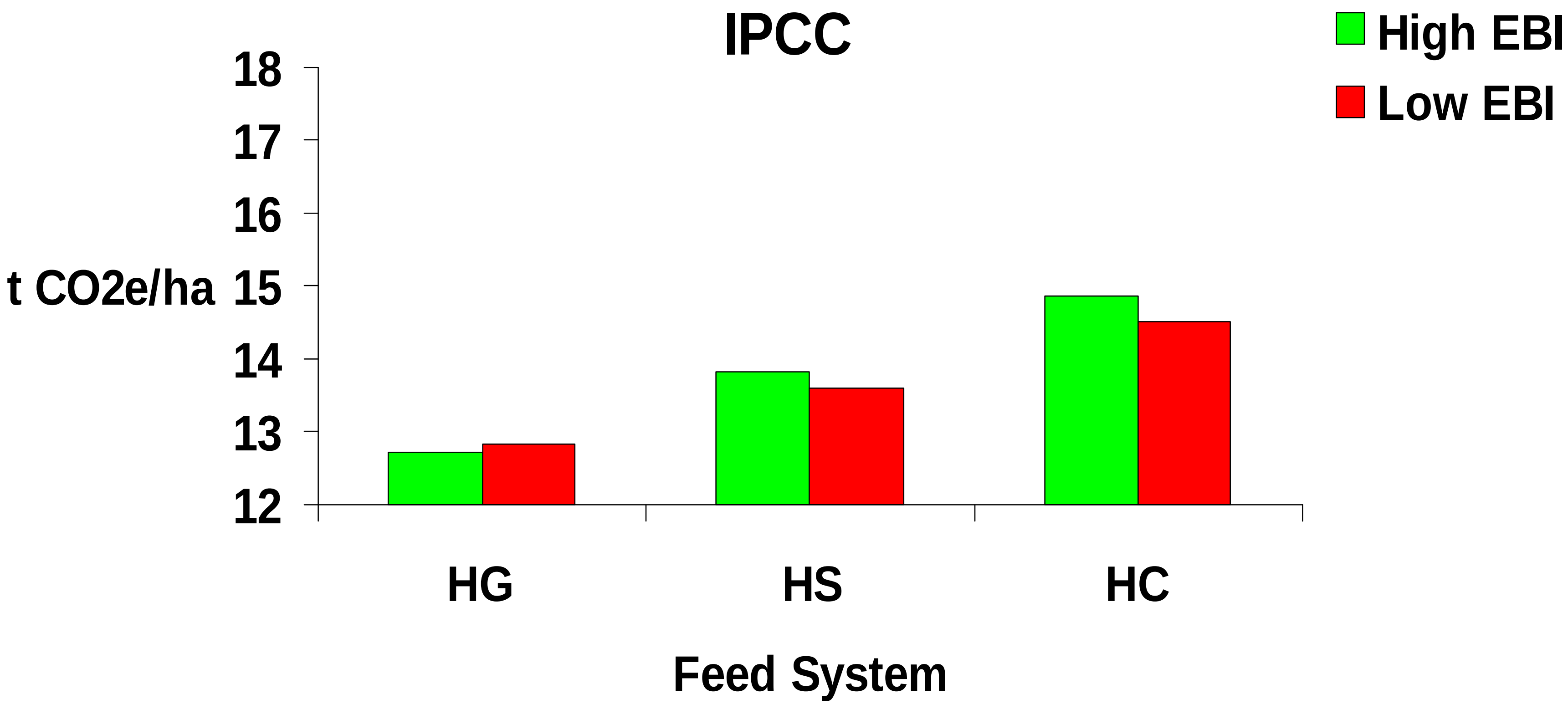
- 2 Genotypes
  - Low EBI (EBI €51)
  - High EBI (EBI €75)

- 3 Feed Systems
  - High grass allowance (HG)
    - 2.47 cows/ha and 325kg concentrate/cow
  - High stocking rate (HS)
    - 2.74 cows/ha and 325kg concentrate/cow
  - High concentrate supplementation (HC)
    - 2.47 cows/ha and 1445kg concentrate/cow

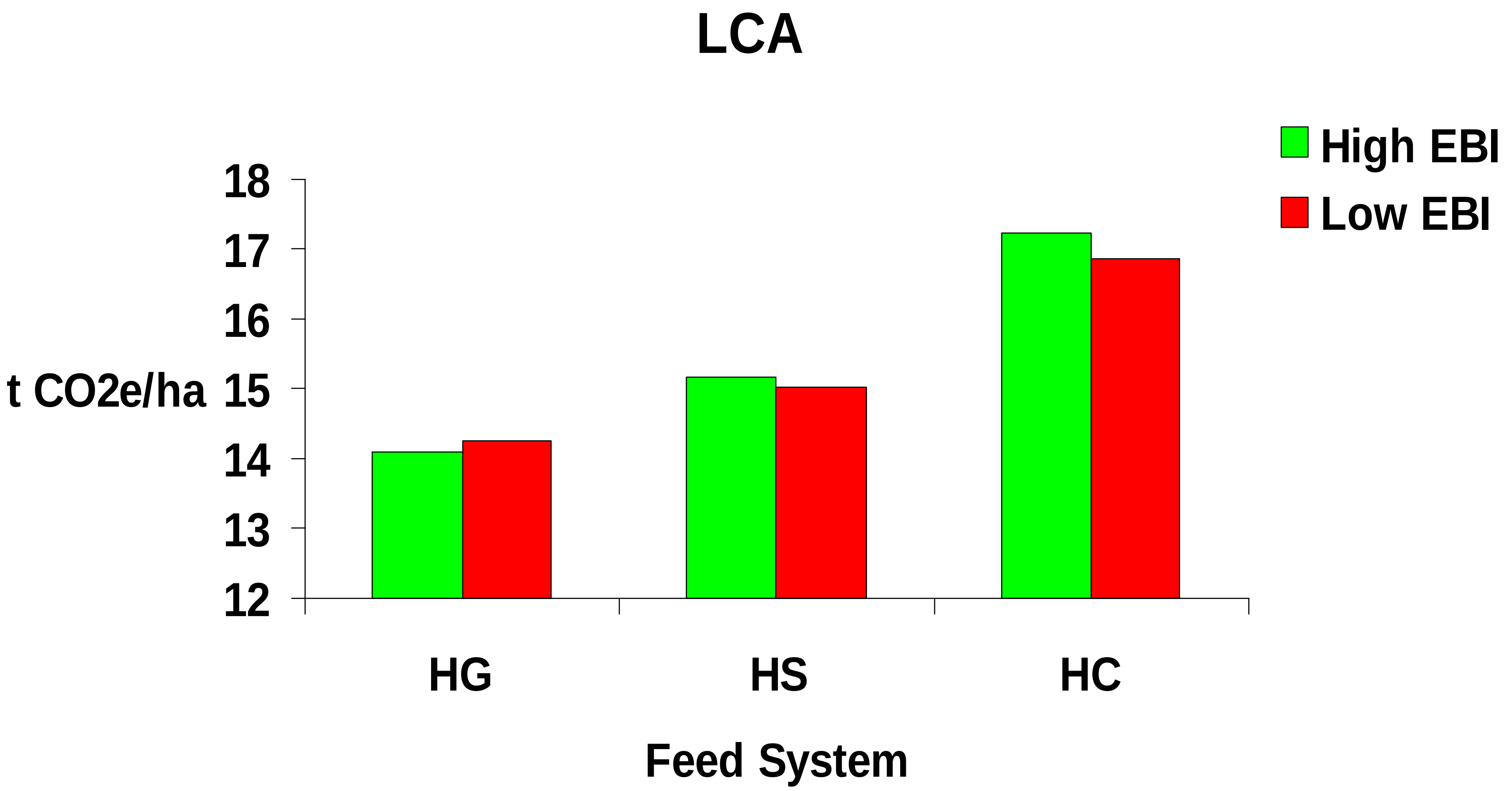
- Trial design and activity data sourced from Horan et al. (2005) and McCarthy et al. (2007)

Results

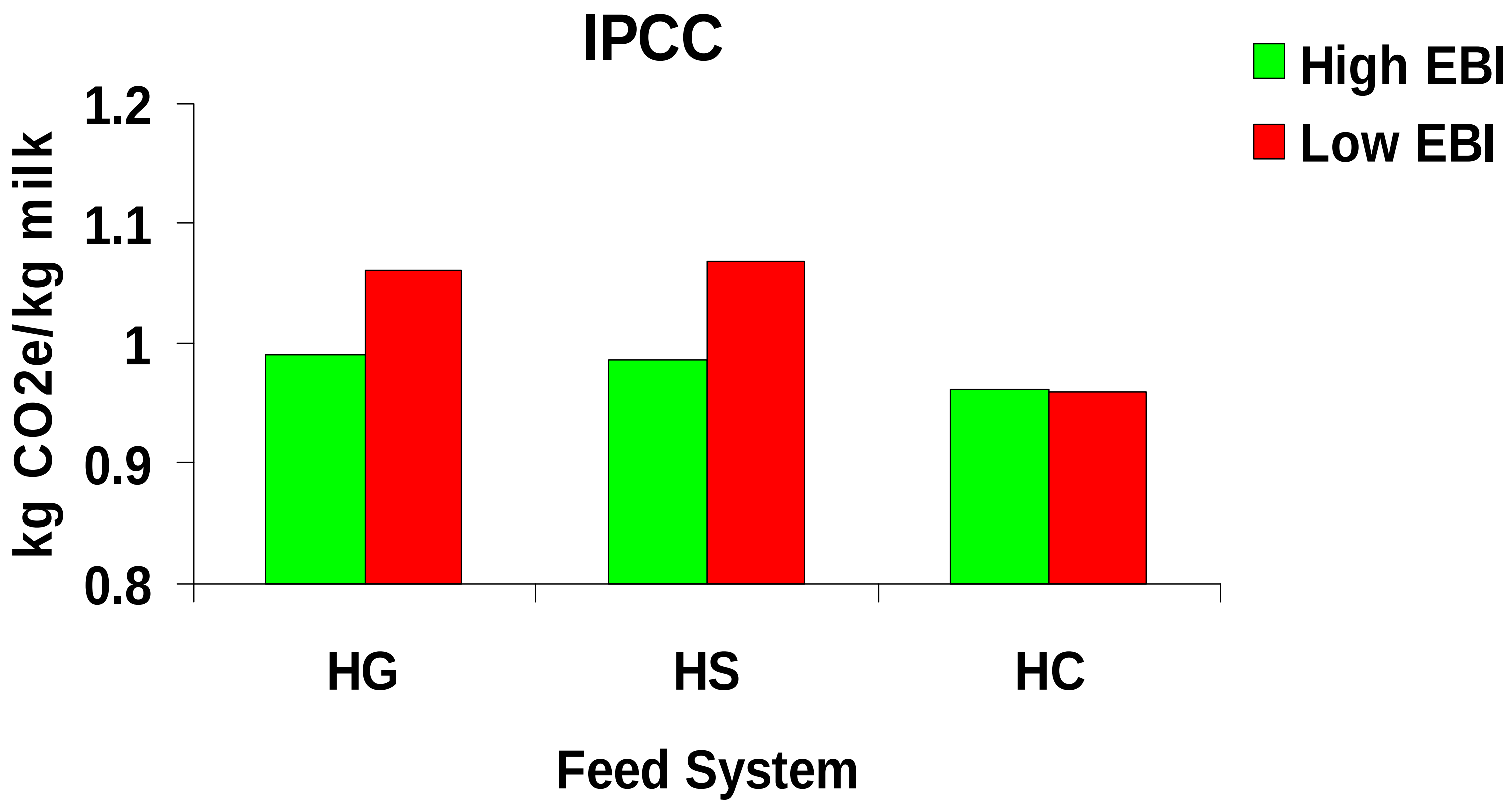
GHG emissions per unit area



GHG emissions per unit area



GHG emissions per kg of Milk



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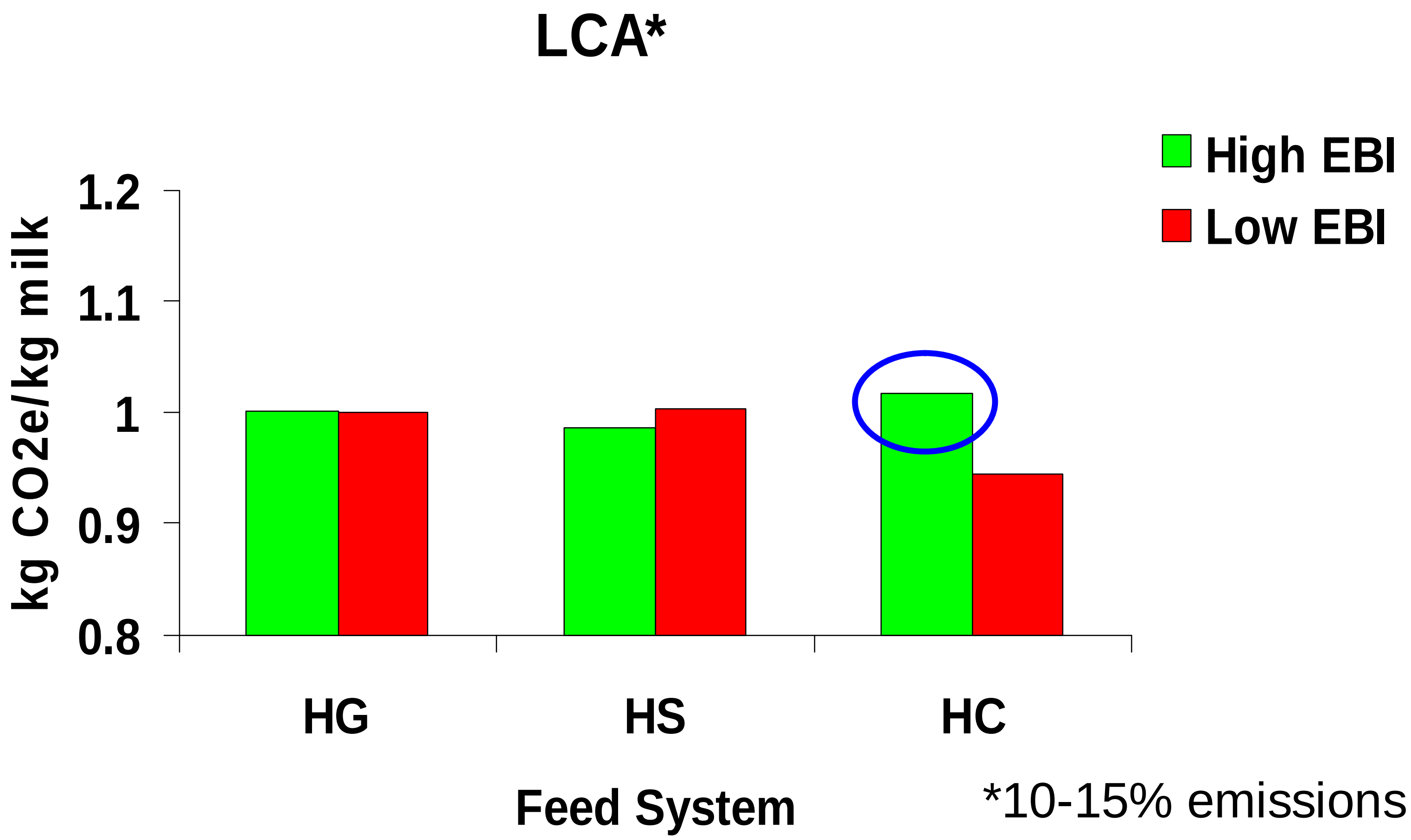
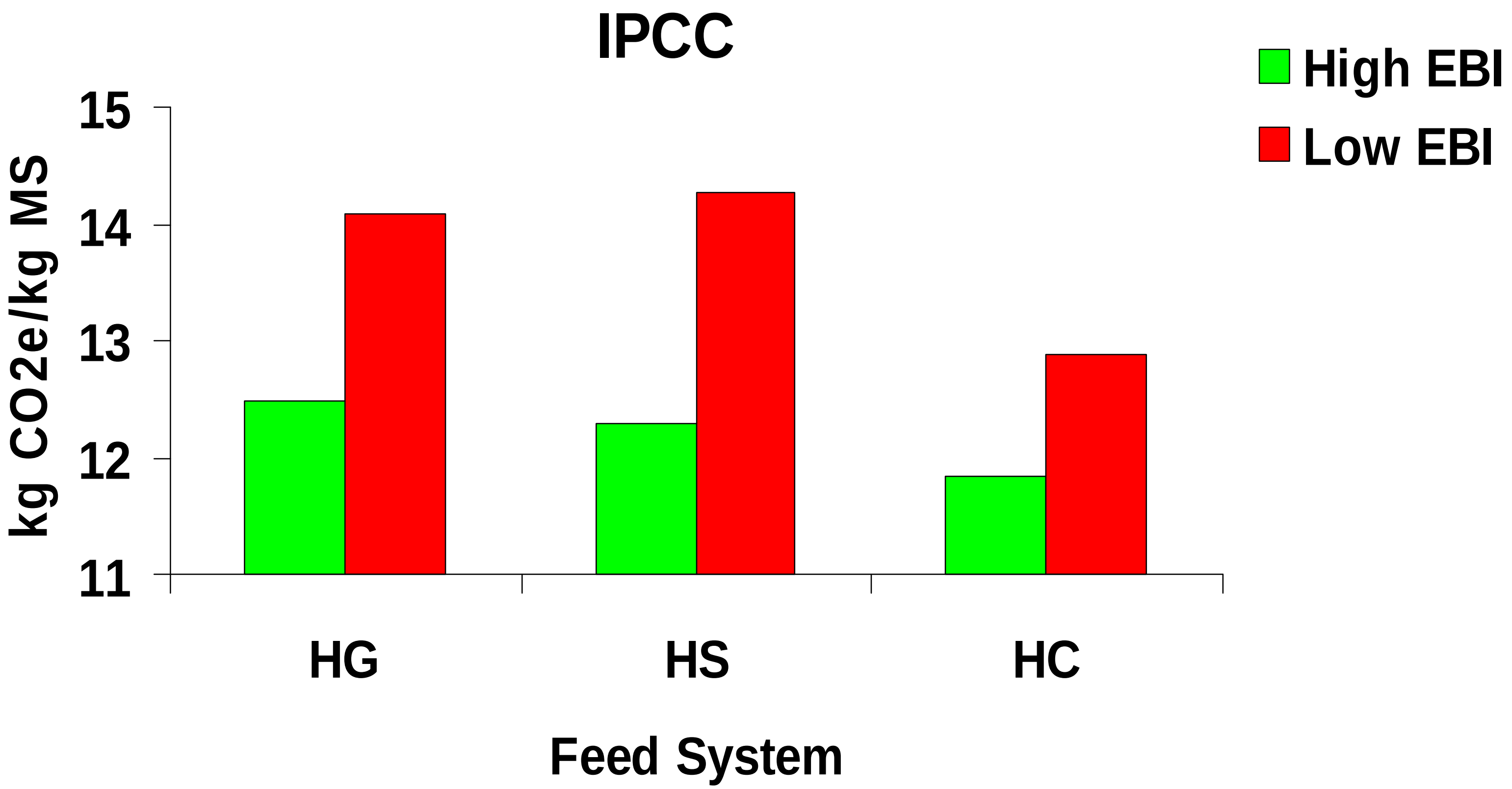
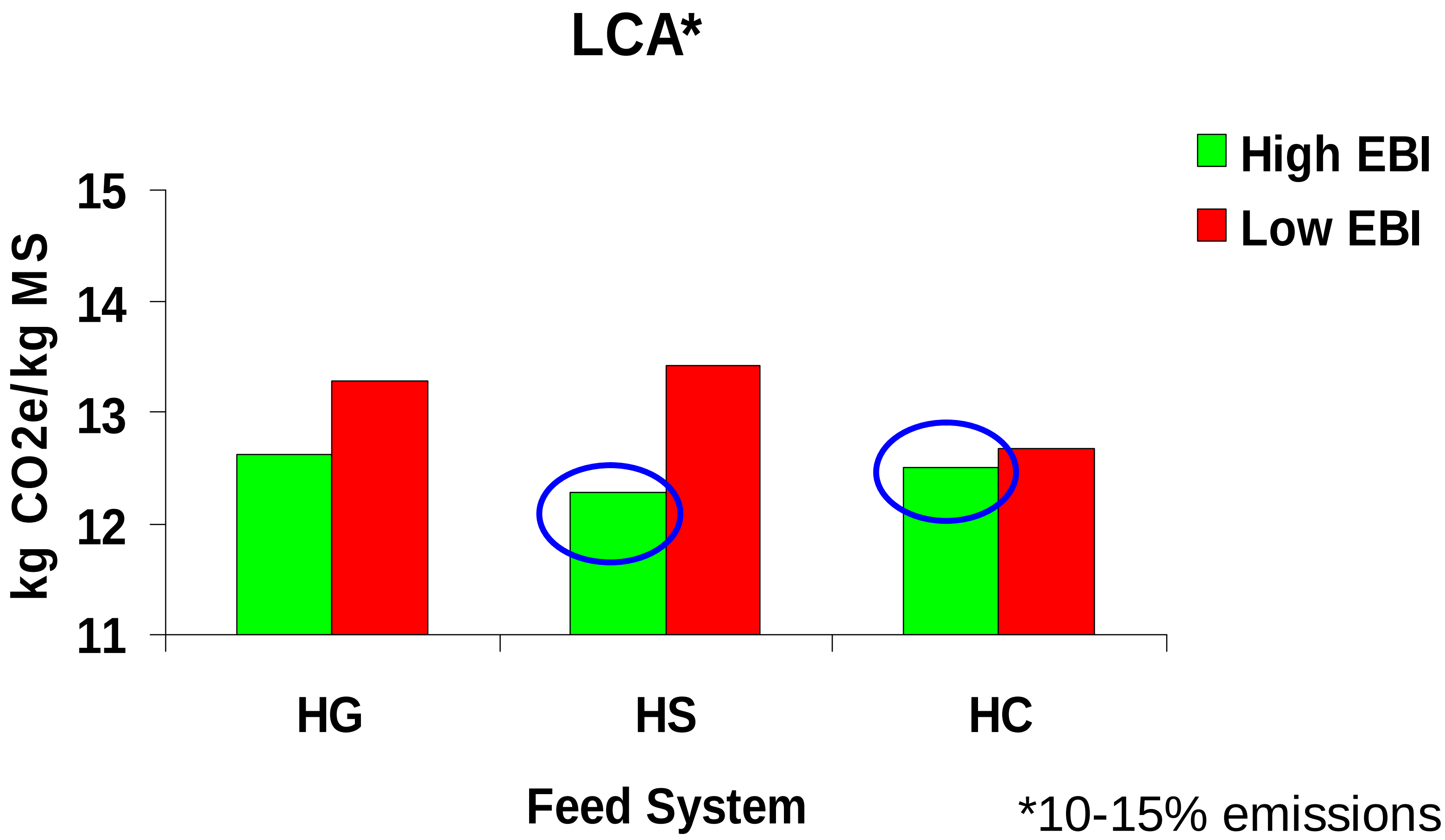


*10-15% emissions allocated to beef

GHG emissions per kg of Milk Solids



GHG emissions per kg of Milk Solids



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Implications

- Increasing EBI results in reduced emissions per unit product
- Ranking of dairy farm emissions differs depending on unit of expression
- Complying with policy methods (IPCC) and reduction targets does not guarantee emissions to environment are reduced
- Holistic Analysis such as LCA ensures net emissions are reduced

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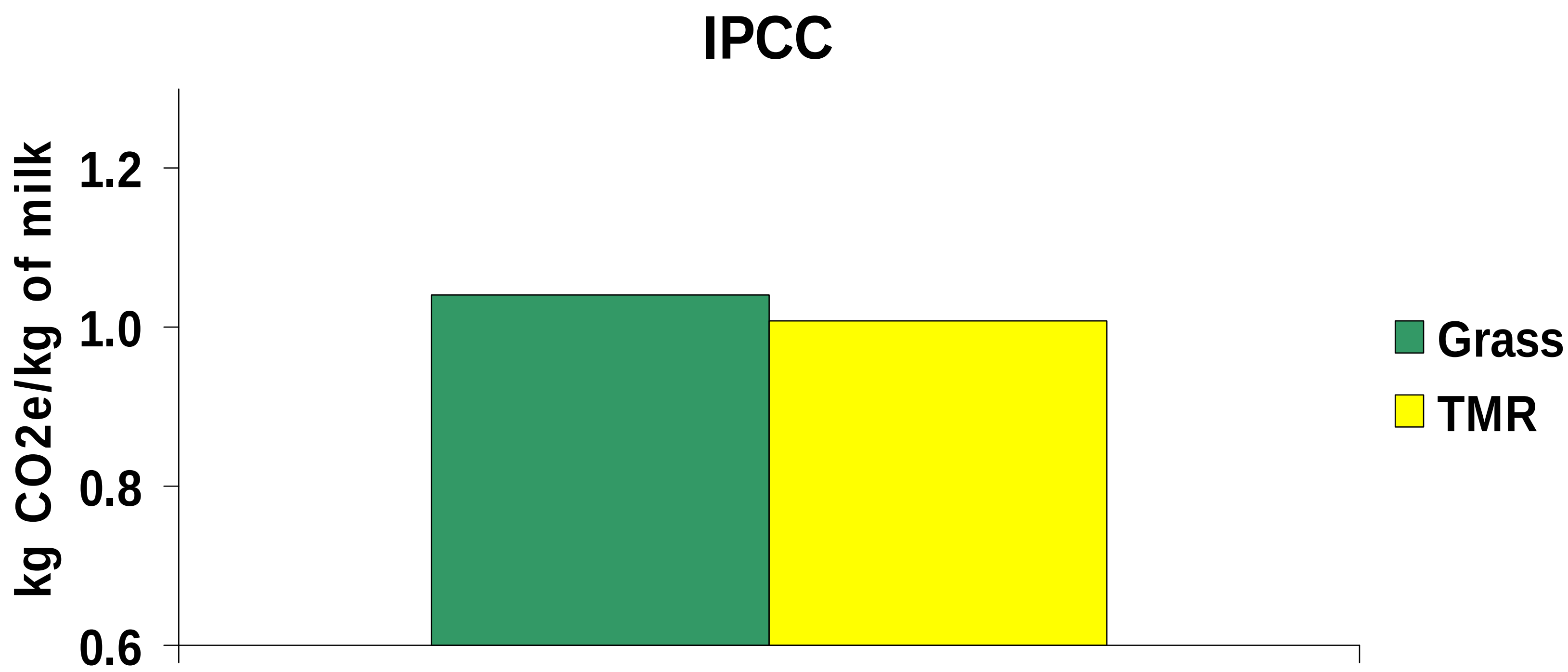
Effect of TMR and Grass feed systems on GHG emissions

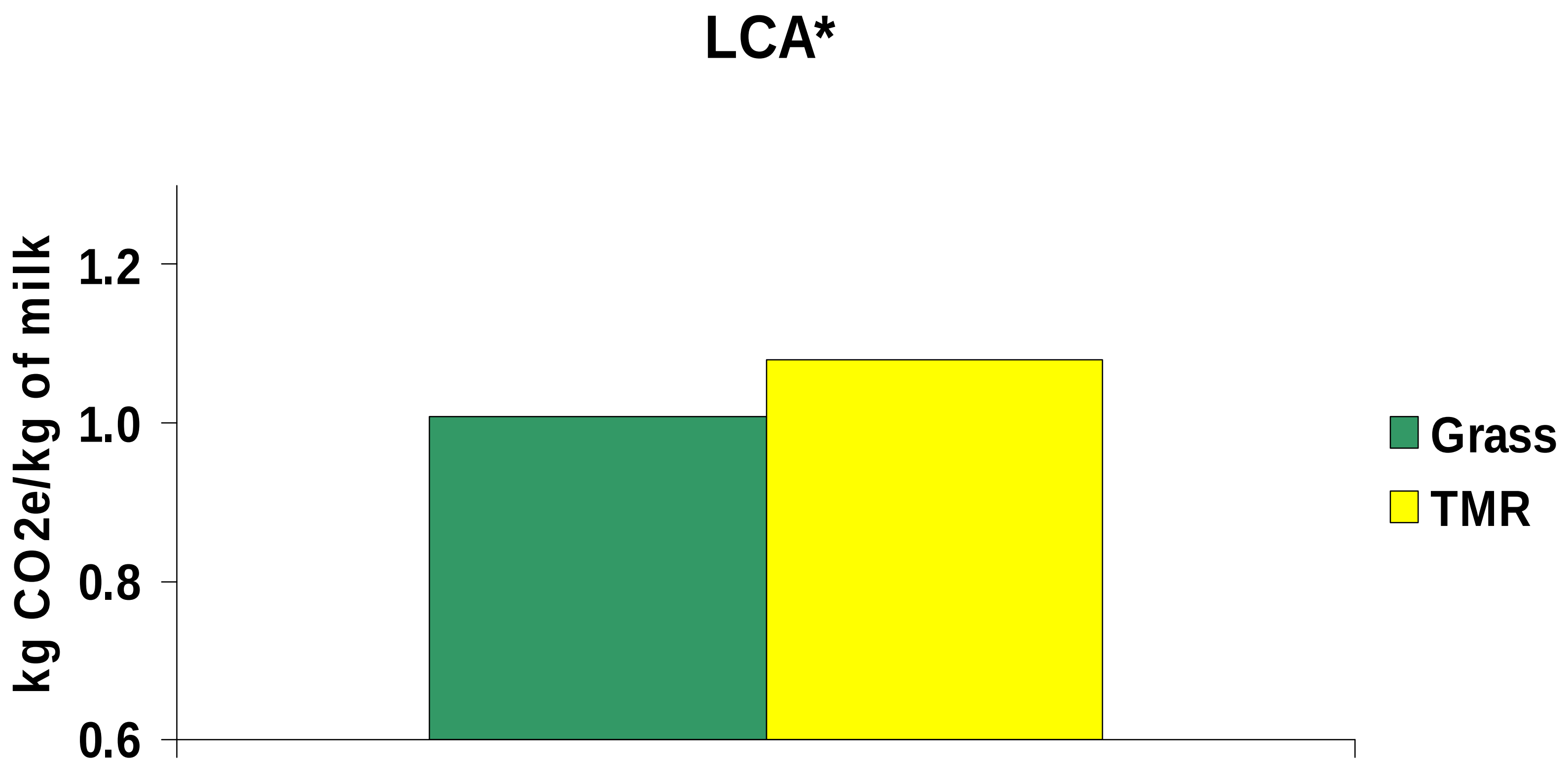
- Biological and Physical data sourced from Patton (Submitted)
- Genotype and number of cows fixed
- Grass treatment offered 425 kg DM concentrate early lactation
- Total mixed ration components
  - Maize Silage, Grass Silage, Molasses, Soybean, Straw and Concentrate

Results

GHG emissions per kg of Milk



GHG emissions per kg of Milk



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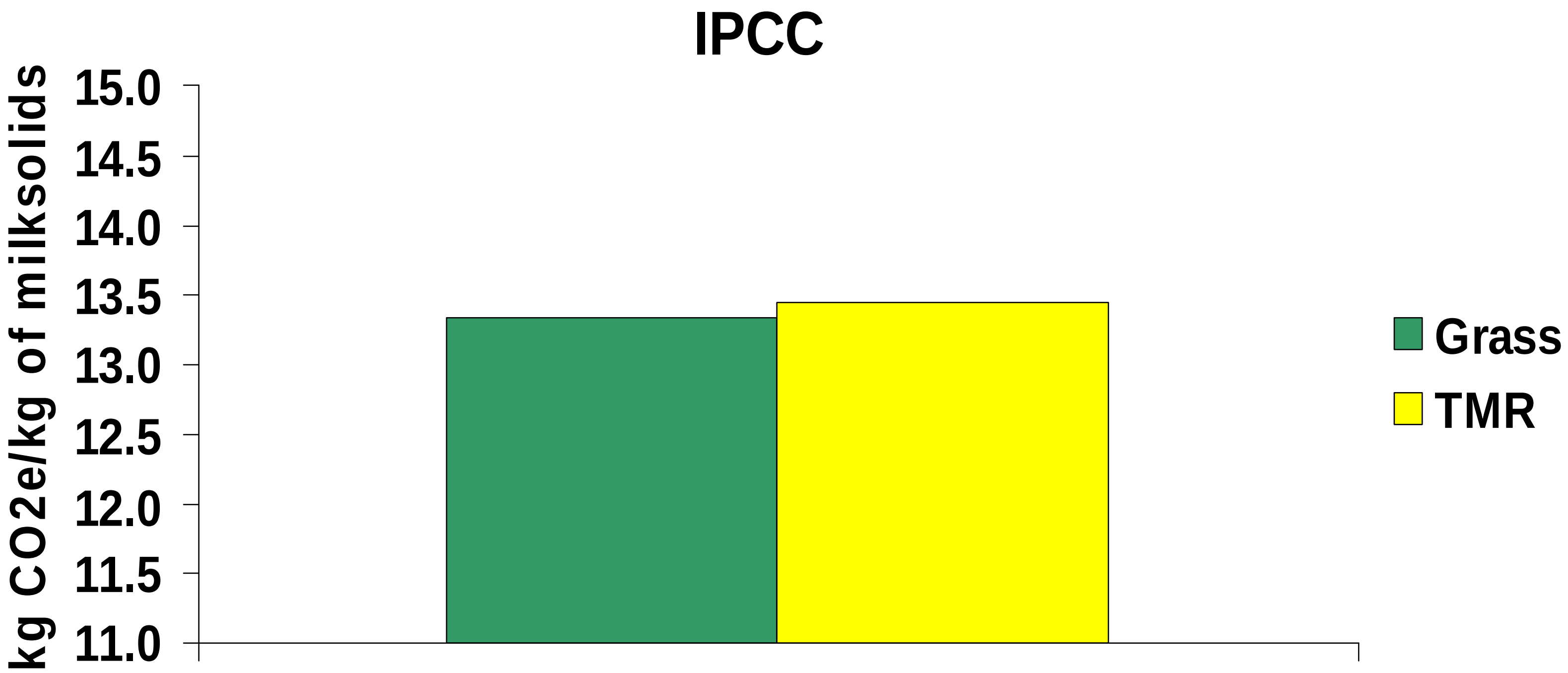
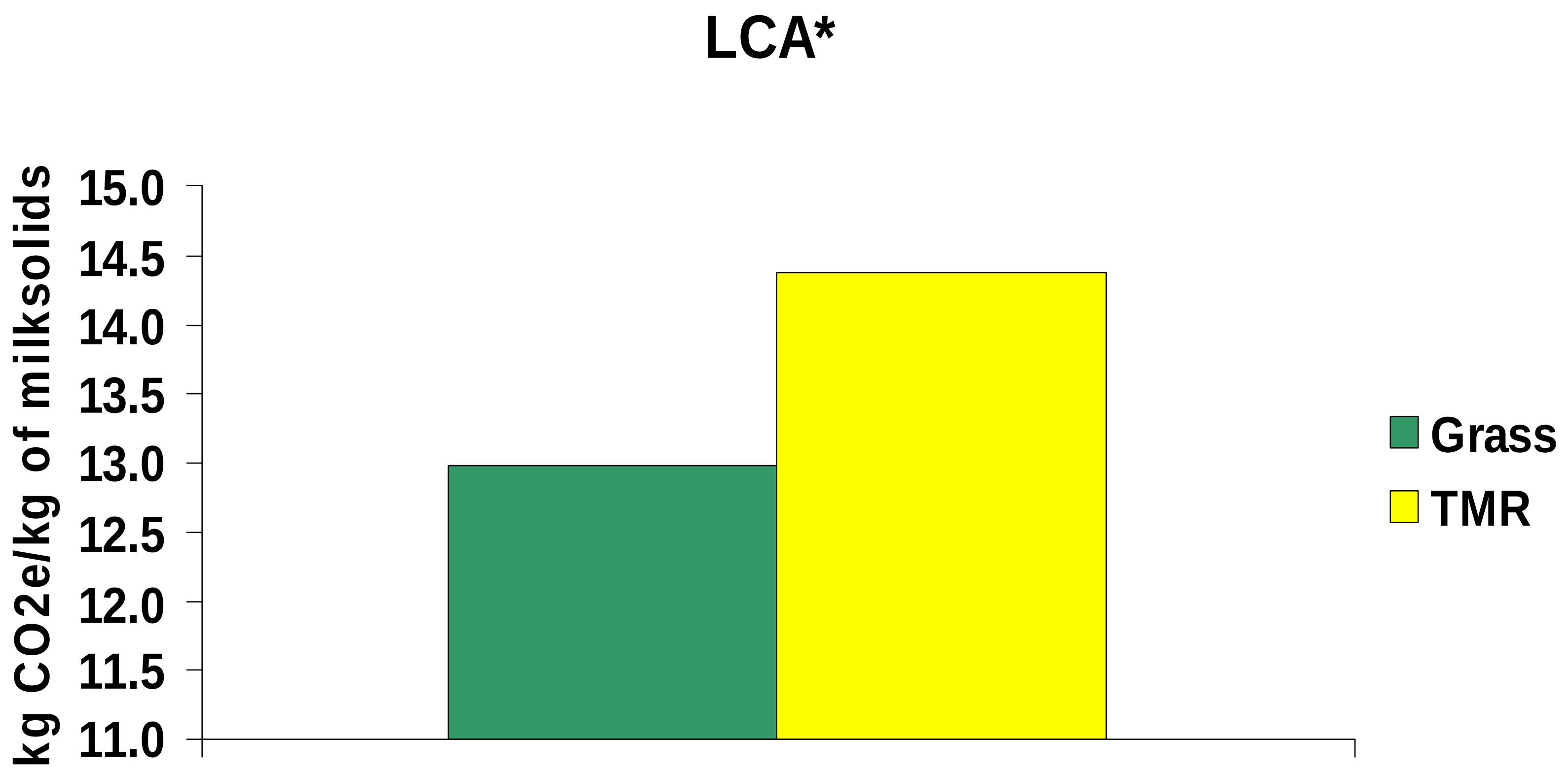
GHG emissions per kg of Milk Solids



GHG emissions per kg of Milk Solids



*10% allocated to beef

Sensitivity Analysis

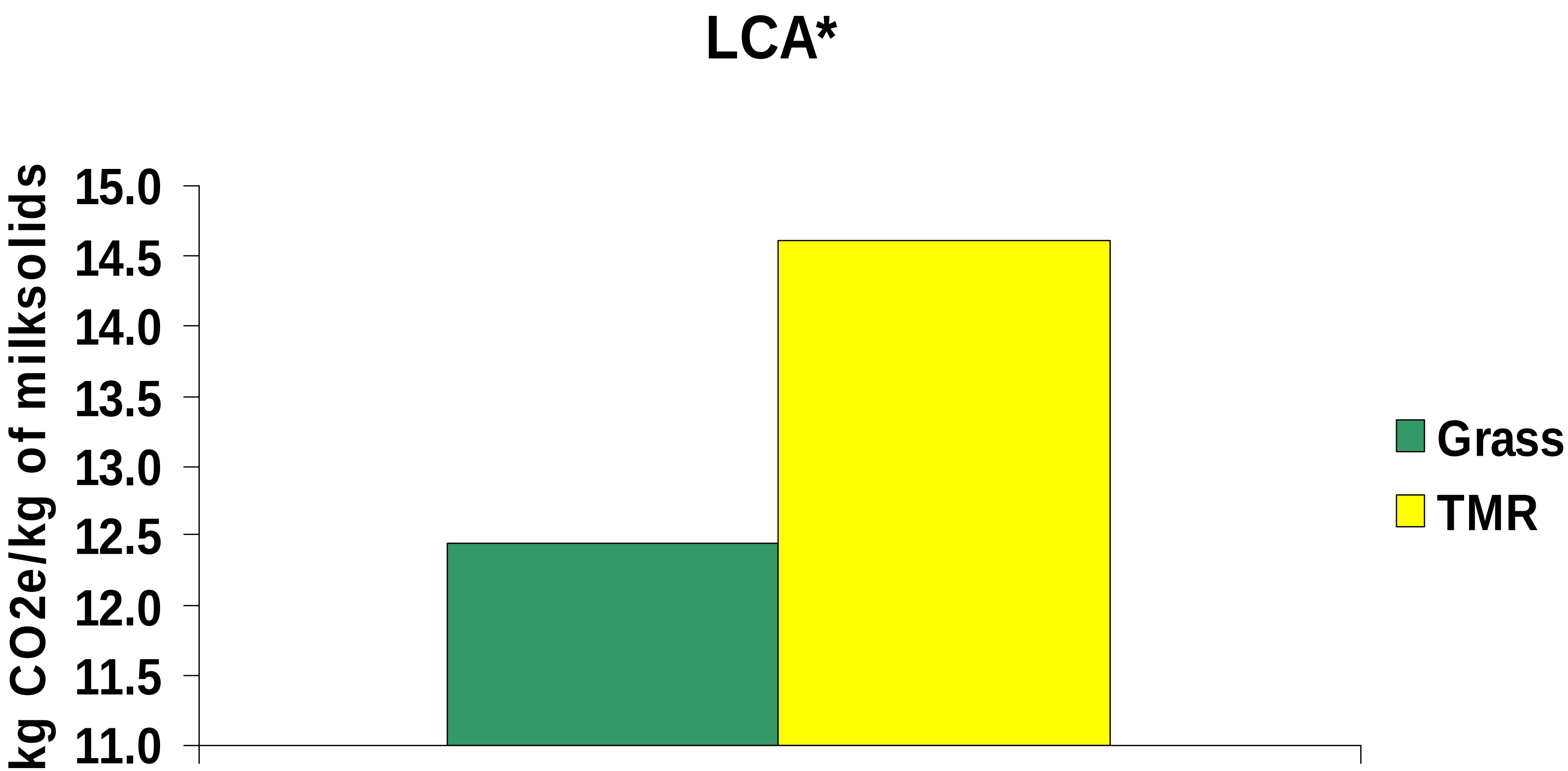
- Enteric Fermentation emissions estimated using Irish measurements (O'Neill, submitted)

- Evaluation of diet effect on methane emissions;
  - TMR vs. Grass

- Emissions measured twice over 10 week period
  - 23rd March to 31st May

- Methane emissions per kg of DMI
  - TMR
    - 20.1 to 20.4 g CH_4/kg DMI
  - Grass
    - 17.1 to 19.1 g CH_4/kg DMI

GHG emissions per kg of Milk Solids



*10% allocated to beef

Implications

- The optimum system to reduce emissions per kg of product is dependant on method of quantification and expression
  - IPCC or LCA
  - Milksolids or milk volume

- Holistic analysis demonstrates that adopting TMR systems does not reduce GHG emissions per unit of product

Closing thoughts

- GHG is a global issue not just a local problem
- GHG is only one of a number of global issues and should not be viewed in isolation
  - Energy and Food Security
  - Water Scarcity
- Policy reform required to reduce GHG emissions in light of other global challenges
  - LCA
  - Product Target

Thank you

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NDP
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Input data

	Feed System	
	Grass	TMR
Cow feed intake kg/DM	5300	6607
Milk yield/cow (kg)	6244	7780
Milk solids/cow (kg)	486	585